

CLAIMS

We claim:

1. A method of providing user control of interactions in a computer display of an item, comprising:
 - a) Displaying a portion of the item;
 - b) Determining if a user-positioned cursor is within a threshold distance from an interaction boundary within the display, and if so, then:
 - i) applying a force to the cursor and communicating the force to the user;
 - ii) determining an input responsive force applied by the user to the input device;
 - iii) changing the portion of the item displayed, wherein the rate of change is determined from the input responsive force.
2. The method of Claim 1 wherein changing the portion of the item displayed comprises changing the display to correspond to a portion adjacent the previous portion in the direction of the boundary.
3. The method of Claim 1 wherein the item is a computer representation of a document.
4. The method of Claim 1 wherein the rate of change increases with increasing input responsive force.
5. The method of Claim 3 wherein scrollable boundaries correspond to the top and bottom of the display, and wherein scrolling in the direction of the top boundary is disabled when the top of the document is displayed, and wherein scrolling in the direction of the bottom boundary is disabled when the bottom of the document is displayed.
6. In a computer system providing display of a computer representation of a document, and user selection of the portion of the document to be displayed, a method of providing user control of scrolling among portions of the document comprising:
 - a) From the boundaries of the portion of the document displayed, determining which correspond to limits of the document;

- b) For each boundary, establishing a haptic boundary in the range of motion of an input device approximately coincident with the visual boundary in the display;
- c) Determining the position of a haptic cursor and, if the haptic cursor is near a haptic boundary that does not correspond to a limit of the document, then

- 10 i) Applying a force to the input device resisting motion of the input device toward said haptic boundary;
- ii) Determining a user force applied by the user directed toward said haptic boundary;
- iii) Scrolling the visual display of the document in the direction of said user force.

7. The method of Claim 6, wherein the rate of scrolling is determined from the magnitude of the user force.

8. In a computer interface comprising a display and a haptic space, a method of providing user control of interactions, comprising:

- a) Displaying a portion of an item;
- b) Providing a control portion of the haptic space;
- 5 c) Determining if a user-positioned haptic cursor is within the control portion, and if so, then determining if the haptic cursor is within a threshold distance from a controllable boundary of the control portion, and if so, then:

- i) applying a feedback force to a user input device affecting additional motion of the cursor relative to the boundary;
- 10 ii) determining an input force applied by the user to the input device;
- iii) changing display of the item, wherein the rate of change is determined from the input force.

9. The method of Claim 8, wherein the rate of change is determined from the magnitude of the input force.

10. The method of Claim 8, wherein the control portion is activated responsive to direction of the user.

11. The method of Claim 8, wherein determining if a user-positioned haptic cursor is within the control portion comprises moving the haptic cursor responsive to user control of an input device, and determining if such movement moves the haptic cursor within the control portion.
12. The method of Claim 8, wherein determining if a user-positioned haptic cursor is within the control portion comprises detecting an indication from the user to move the cursor into the control portion.
13. The method of Claim 8, wherein providing a control portion comprises providing haptic boundaries separating the control portion from the remainder of the haptic space.
14. The method of Claim 13, wherein determining if a user-positioned haptic cursor is within the control portion comprises moving the haptic cursor responsive to user control of an input device, and determining if such movement moves the haptic cursor near a boundary, and if so, then applying a force to a user input device affecting further motion relative to said boundary.
15. In a computer interface comprising a display and a haptic space and adapted to display a document; a method of providing user control of scrolling the display of the document comprising:
 - a) Providing a scrolling zone portion of the haptic space, said portion disposed near an edge of the display of the document and extending from a first end to a second end oriented substantially parallel to the edge;
 - b) Determining the position of a user-controllable cursor in the haptic space, and, if the user cursor is within the scrolling zone portion and within a threshold distance of the first end or the second end, then applying a feedback force to a user input device resisting motion of the haptic cursor toward the nearest end, and determining the magnitude of a force applied by the user in opposition to said feedback force, and scrolling the display of the document in the direction according to the nearest edge at a rate determined from the magnitude of the user-applied force.

16. In a computer interface comprising a display and a haptic space and adapted to display a document, a method of providing user control of the display of the document comprising:

- a) Detecting user activation of a control mode of interface;
- b) When not in control mode, providing a computer interface suitable for interaction with the document;

c) When in control mode:

- i) establishing haptic boundaries relative to the position of a user-controlled cursor when the user activated the control mode of the interface;
- ii) determining the position of a user-controlled cursor in the haptic space, and, if the cursor is within a threshold distance of a haptic boundary, then applying a feedback force to a user input device affecting further motion of the cursor relative to said haptic boundary;
- iii) determining the magnitude of a user-input force applied by the user to the user input device, and changing the display of the document in a direction according to the haptic boundary nearest the cursor at a rate determined from the magnitude of the user-input force.

17. A computer-readable medium having stored thereon computer-executable instructions for performing the method of Claim 1.

18. A computer-readable medium having stored thereon computer-executable instructions for performing the method of Claim 6.

19. A computer-readable medium having stored thereon computer-executable instructions for performing the method of Claim 8.

20. A method of controlling interaction with a computer display of a document, comprising:

- a) Determining an input force applied by the user to an input device;
- b) Changing the display of the document according to the direction and magnitude of the input force.

21. A method of controlling interaction with a computer display of a document, comprising:

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- a) providing a three-dimensional control zone;
 - b) determining if the user indicates a transition into the control zone, and if so, then determining if the user positions a cursor near a boundary of the control zone, and if so, then determining an input force applied by the user to an input device and changing the display according to the direction and magnitude of the input force;
 - c) determining if the user indicates a transition out of the control zone, and if so, then providing interaction according to an application associated with the document.